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Multi-lag cluster designs for estimating the semivariogram of sediment contaminants from effluent discharge offshore in San Diego

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ABSTRACT

Maps are useful tools for understanding, managing, and protecting the marine environment, yet few useful and statistically defensible maps of environmental quality and aquatic resources have been developed in near-coastal regions. Current environmental management efforts, such as ocean monitoring by sewage dischargers, routinely sample areas of potential impact using sparse sampling grids. Heterogeneous oceanic conditions often make extrapolation from these grids to non-sampled locations questionable. Although rarely applied in coastal monitoring, kriging offers a more rigorous statistical approach to mapping and allows confidence intervals to be estimated for predictions. Its usefulness relies on accurate models of the spatial variability through estimating the semivariogram. Many optimal designs for estimating the semivariogram have been proposed, but these designs are often difficult to implement in practice. In this paper, we present simple design strategies for augmenting existing monitoring designs with the goal of estimating the semivariogram. In particular, we investigate a multi-lag cluster design strategy, in which clusters of sites, spaced at various lag distances, are placed around fixed stations on an existing sampling grid. We find that these multi-lag cluster designs provide improved accuracy in estimating the parameters of the semivariogram. Based on simulation study findings, we apply a multi-lag cluster enhancement to the monitoring grid for the City of San Diego's Point Loma Wastewater Treatment Plant as part of a special study to map chemical contaminants in sediments around its sewage outfall.

Full Text

ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/AnnualReports/2005_06AnnualReport/AR0506_315-326.pdf